Intergovernmental Oceanographic Commission
Reports of Meetings of Experts and Equivalent Bodies

IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources

Third Session

Paris, 5-9 February 1990

UNESCO

In this Series, entitled

Reports of Meetings of Experts and Equivalent Bodies, which was initiated in 1984 and which is published in English only, unless otherwise specified, the reports of the following meetings have already been issued:

1. Third Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
2. Fourth Meeting of the Central Editorial Board for the Geological/Geophysical Atlases of the Atlantic and Pacific Oceans
3. Fourth Session of the Joint IOC-WMO-CPPS Working Group on the Investigations of «El Niño» *(Also printed in Spanish)*
4. First Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in relation to Living Resources
5. First Session of the IOC-UN(OETB) Guiding Group of Experts on the Programme of Ocean Science in relation to Non-Living Resources
6. First Session of the Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
7. First Session of the Joint CCOP(SOPAC)-IOC Working Group on South Pacific Tectonics and Resources
8. First Session of the IODE Group of Experts on Marine Information Management
9. Tenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies in East Asian Tectonics and Resources
10. Sixth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
11. First Session of the IOC Consultative Group on Ocean Mapping *(Also printed in French and Spanish)*
12. Joint IOC-WMO Meeting for Implementation of IGOSS XBT Ships-of-Opportunity Programmes
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14. Third Session of the Group of Experts on Format Development
15. Eleventh Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of South-East Asian Tectonics and Resources
16. Second Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
17. Seventh Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
18. Second Session of the IOC Group of Experts on Effects of Pollutants
19. Primera Reunión del Comité Editorial de la COI para la Carta Batimétrica Internacional del Mar Caribe y Parte del Océano Pacífico frente a Centroamérica *(Spanish only)*
20. Third Session of the Joint CCOP/SOPAC-IOC Working Group on South Pacific Tectonics and Resources
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22. Second Session of the IODE Group of Experts on Marine Information Management
23. First Session of the IOC Group of Experts on Marine Geology and Geophysics in the Western Pacific
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25. Third Session of the IOC Group of Experts on Effects of Pollutants
26. Eighth Session of the IOC-UNEP Group of Experts on Methods, Standards and intercalibration
27. Eleventh Session of the Joint IOC-IHO Guiding Committee for the General Bathymetric Chart of the Oceans *(Also printed in French)*
28. Second Session of the IOC-FAO Guiding Group of Experts on the Programme of Ocean Science in Relation to Living Resources
29. First Session of the IOC-IAEA-UNEP Group of Experts on Standards and Reference Materials
30. First Session of the IOCARIBE Group of Experts on Recruitment in Tropical Coastal Demersal Communities *(Also printed in Spanish)*
31. Second IOC-WMO Meeting for Implementation of IGOSS XBT Ship-of-Opportunity Programmes
32. Thirteenth Session of the Joint CCOP-IOC Working Group on Post-IDOE Studies of East Asia Tectonics and Resources
33. Second Session of the IOC Task Team on the Global Sea-Level Observing System
34. Third Session of the IOC Editorial Board for the International Bathymetric Chart of the Mediterranean and Overlay Sheets
35. Fourth Session of the IOC-UNEP-IMO Group of Experts on Effects of Pollutants
36. First Consultative Meeting on RNODCs and Climate Data Services
37. Second Joint IOC-WMO Meeting of Experts on IGOSS-IODE Data Flow
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45. Ninth Session of the IOC-UNEP Group of Experts on Methods, Standards and Intercalibration
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57. First Meeting of the IOC *ad hoc* Group of Experts on Ocean Mapping in the WESTPAC Area
58. Fourth Session of the IOC Consultative Group on Ocean Mapping
59. Second Session of the IOC-WMO/IGOSS Group of Experts on Operations and Technical Applications
60. Second Session of the IOC Group of Experts on the Global Sea-level Observing System
61. UNEP-IOC-WMO Meeting of Experts on Long-Term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change
62. Third Session of the IOC-FAO Group of Experts on the Programme of Ocean Science in Relation to Living Resources

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1. OPENING

1 The IOC Senior Assistant Secretary, Dr. Jürgen Alheit, welcomed the participants of the Session on behalf of the IOC Secretary, Dr. Gunnar Kullenberg. Dr. Andrew Bakun, Chairman of the Guiding Group of Experts, opened the Session by introducing the new participants and identifying their affiliations.

2 The list of participants is given in Annex III.

2. ADMINISTRATIVE ARRANGEMENTS

2.1 ADOPTION OF THE AGENDA

3 The Provisional Agenda (Doc.IOC-FAO/GGE-OSLR-III/1 prov.) was introduced by the Chairman for consideration by the Group. Several items were added and the adjusted Agenda was adopted by the Guiding Group (Annex I).

2.2 DESIGNATION OF RAPPORTEUR

4 Dr. Michael Sinclair was proposed as Rapporteur for the Session by the Chairman. This proposal was unanimously accepted.

2.3 CONDUCT OF THE SESSION, TIME TABLE AND DOCUMENTATION

5 Dr. Alheit reviewed the list of Documents available for the Session and announced that Drs. P. Rothlisberg, J-P Troadec and A. Yanez-Arancibia were unable to participate in the Session. The List of Documents distributed for the Session is given in Annex IV.

3. REVIEW OF INTERSESSIONAL ACTIVITIES

3.1 INTERNATIONAL RECRUITMENT PROGRAMME (IREP)

3.1.1 General Overview of the Programme

6 IREP has been in operation for about five years. It was thought useful as an introduction to this review of inter-sessional activities of the components of IREP to provide a brief sketch of the original rationale for the Programme, as well as an overview in the growth of the components. Resolution XII-1 of the 1982 Twelfth Session of the IOC Assembly recognized that a key problem in fisheries management was the lack of understanding of the processes influencing recruitment to fish stocks. In the early 1980's in spite of considerable research efforts, principally by fishery scientists, explanatory power concerning recruitment variability was limited. It was felt that recent increases in understanding of oceanographic processes could help to define new multi-disciplinary approaches to the recruitment variability problem.

7 A central thrust of IREP has been to use the comparative approach in order to increase the matrix of environmental and year class survivorship observations. It was proposed that similar species be studied in replicate environmental contexts (such as the sardine/anchovy species pairs in a number of upwelling systems), as well as several populations of the same species in a range of environmental situations (such as the diverse herring and cod populations in the North Atlantic). It was argued that nature has provided a rich set of "experimental" designs. By careful selection of observations on the oceanographic and population processes in different locations inferences could fairly rapidly be drawn (3-5 years) concerning the processes of importance in regulating fish abundance.

8 A second thrust was to increase the spatial and temporal resolution of observations within the early life history period. As in the comparative approach between geographic areas (or between populations) stated above, this second strategy aimed at increasing the probability of linking patterns in fish, egg and larval survivorship to meso- and small scale variability in the oceanographic environment. New methodology in sampling both

the early life history stages and the oceanographic environment suggested that renewed efforts of this type would be fruitful.

9 Several multi-disciplinary "fisheries oceanographic" projects were initiated following the above strategies. The Sardine/Anchovy Recruitment Project (SARP) encompassed both elements. The initial comparative approach was to be between the Peruvian and Californian upwelling systems, and their resident population of sardines and anchovies. The SARP community gradually grew to include six different systems. The key component was to be the application of methods developed in the late 1970's and early 1980's in the research group led by the late Dr. R. Lasker in the Southwest Fisheries center (La Jolla).

10 Representative aging of early stage juveniles, using the daily growth rings on the otolith, allow estimates of the temporal distribution in the birth dates of the survivors. The second method was the estimation of population larval production by repetitive field surveys throughout the distribution range of the population during the extended batch spawning period. If such a full programme were to be conducted, with estimates of (i) the frequency distribution of the age of the survivors to the early juvenile stage and (ii) of larval production by day, differential survival rates of the various cohorts of larvae could in principle be calculated. The temporal and spatial pattern in mortality and survivorship could then be analyzed in relation to temporal patterns in the oceanographic environment. Unfortunately to date the original full SARP protocol has never been undertaken because of funding constraints.

11 After 1985, SARP has evolved in two directions, both of which are less demanding of shiptime. The first approach has been to describe detailed patterns in both larval age and larval condition in relation to spatial variability in the oceanographic environment. From the patterns inferences are being drawn on the relative importance of starvation and predation in the definition of year-class strength. The costly larval production surveys have in most cases been eliminated from the SARP sampling design. The second thrust has been to enhance the modelling approach using accumulated empirical observations (see the Peruvian anchoveta project) and to enhance comparison between upwelling systems.

12 The Second major component of IREP is the Tropical Demersal Recruitment Project (TRODERP). This component was specifically developed to include recruitment studies in diverse tropical ecosystems for which the SARP concept is inapplicable. This component is inevitably much less unified than SARP because of the wider range of environments (estuaries, reefs, coastal embayments etc..) and of life histories (shrimps and fish). The comparative approach, however, is a key strategy for many of the projects.

13 There are two projects within TRODERP that deal with shrimp, one in the IOCARIBE area and one in the WESTPAC area. They are entitled the Penaeid Recruitment Projects (PREP).

14 The IOCARIBE area also has recruitment projects addressing coral reef systems (the Coral Reef Demersal Recruitment Project, or CORDERP) and estuarine environments (Fish Estuarine Deltaic Recruitment Project, or FEDERP).

3.1.2 Sardine/Anchovy Recruitment Project (SARP)

3.1.2.1 Summary of Intersessional Activities

15 Implementation of SARP on the regional level continued successfully and a considerable number of developing and developed countries (13) are involved in this initiative now.

16 Sprat recruitment in the North Sea is studied co-operatively by the U.K. (Plymouth), Denmark (Copenhagen) and the FRG (Bremerhaven). In 1989, the impact of the frontal systems in the German Bight (tidal mixing fronts,

river plume fronts) on larval condition and growth rates was studied intensely.

17 The joint Portuguese-Spanish studies on the sardines in the Iberian upwelling system continued as planned. They were supported by scientists from the Southwest Fisheries Center in California. In 1988, the Egg Production Method for spawning biomass estimates was applied successfully to the sardine stocks in Portuguese and Spanish waters. Results of these studies were discussed at a Workshop in La Jolla, 30 October - 3 November 1989 and are prepared for publication now.

18 These two European SARP initiatives will join and receive considerable funding from the European Community for a project on "Co-operative studies on the processes controlling recruitment of clupeiform fish in different regions including sardines, anchovies and sprats.

19 A new SARP project was implemented in 1989 in the SW-Atlantic. Studies on the recruitment of the SW-Atlantic anchovy were initiated in November 1989 by a cruise of the R.V. METEOR made available by the FRG. A team of 27 scientists, fisheries biologists and physical oceanographers, from Argentina, Brazil, Uruguay, the FRG and Sweden participated in this exercise. The details of the cruise plan and the rationale of the research programme were discussed and laid out on two IOC Workshops on the S-Atlantic SARP (Montevideo, 23-25 November and 21-23 August 1989 - IOC Workshop Report No. 65).

20 Although due to several constraints, it was not yet possible to launch a full SARP project in Chile, SARP activities continued on anchovies and sardines and several important results were published. It is expected that funding perspectives for a Chilean SARP will soon improve considerably.

21 The new Mexican project on sardines and anchovies in the Gulf of California recently joined SARP. This project focuses particularly on the interactions between the two species. Japan initiated a new 10-year research project on the sardine stock fluctuations with a large component on recruitment studies. This project was also recently brought into SARP.

22 A training course on the "Egg Production Method" for spawning biomass estimates of small pelagic fish in Bremerhaven, 5-16 December 1988, was attended by 23 scientists from Mexico, Ecuador, Peru, Chile, Argentina, Uruguay, Brazil, Portugal, Spain and Italy. A training course on "SARP Methods" co-sponsored by POLARMAR, FRG, and IOC, in Bremerhaven, 4-15 September 1989 was attended by 15 scientists from Mexico, Chile, Argentina, Uruguay, Brazil, Portugal, Spain and Poland.

23 Interregional exchange of expertise an scientists within SARP was promoted by IOC. Scientists of the SARP teams of Argentina, Uruguay, Brazil and Spain participated in the North Sea cruises on sprat recruitment.

3.1.2.2 *Ad hoc* Expert Consultation on SARP

24 The application of the original SARP concept, the comparison of the juvenile's birthday distribution to the larval production curve determined over the whole spawning period (within year experiment, survivorship experiment) proved unrealistic, mainly because of lack of the considerable funds (ship-time) required. The scope of the *Ad hoc* Expert Consultation on SARP, La Jolla, 30 October - 2 November 1989, was to refocus SARP onto objectives with a higher likelihood of being implemented. The specific objectives were:

(i) To review the state of the regional SARP projects;

(ii) To outline future SARP activities including:

a) reconcile the temporal versus spatial investigation strategies,

b) suggest a uniform methodology,
c) incorporate new technology,
d) determine the role of SARP in assessing the impact of global climate change.

25 The Guiding Group of Experts agreed with the requirement for broadening the conceptual scope of SARP while maintaining the principal objective. This objective is to increase understanding of the processes regulating the abundance of sardine and anchovy populations, in particular the oceanographic and biological processes controlling recruitment variability. The Group did not find the report to have appropriate balance in relation to the above general objective of SARP. The emphasis on future research direction is principally on field and laboratory studies of early life history ecology using state-of-the art techniques. In a certain sense the strategy outlined in the report represents an narrowing of SARP by focussing almost exclusively on the larval stage of the life cycle.

26 The Guiding Group of experts feel that continued emphasis should be directed towards the original aims (and the basic methodological approach) of SARP. The difficulty to date in funding of the so-called full SARP has been the requirement for extensive ship-time to evaluate the within spawning season temporal variability in larvae production. Estimates of bi-weekly larval production are required to estimate the larval stage mortality rates for different within-year larval cohorts. The Group felt that estimates of the within-year temporal distribution of larval production could be derived without the necessity of repetitive field surveys over the six-months of batch-spawning. For populations that are exploited at moderate to high levels careful monitoring of the fishery itself could provide estimates of the temporal distribution of egg production. This approach, however, would not be viable off California because of the lack of an extensive fishery. It may well be appropriate in Japan, Peru, Chile, the west coast of India, the Iberian peninsula and for other populations that are more fully harvested.

27 The Group encouraged the SARP team to maintain a focus on the original methodological approach (while relaxing some of the ship time requirements to fully describe the within-year distribution of larval production). A second possible approach would be to reduce the within-year description of larval production and increase the number of years for which larval mortality for particular cohorts is estimated.

28 The Guiding Group of Experts also felt that the report does not sufficiently outline research questions involving a compilation of time series data sets and modelling. The IMARPE/GTZ/ICLARM Peruvian anchoveta project (which did not involve new field studies on larval ecology) has been considered to be a most fruitful study. The group feels that the successes of that study could be followed in other upwelling systems supporting sardine and anchovy populations. There may well be considerable accumulated data on the fish populations and the oceanographic environment that have not been comprehensively analyzed without being fully aware of the scope for success in other systems, the Group nevertheless encourages the SARP team to consider carefully a modelling approach to the general problem, building on the experience of the Peruvian anchoveta study which is nearing completion.

29 Given that the scope of SARP is being broadened the Guiding Group of Experts feels that more emphasis in the definition of the conceptual approach could be placed on the life cycle as a whole. For example the work of Peterman and Bradford indicate that processes subsequent to late larval stage of Californian modern anchovy are important in the definition of year-class size. This observation has also been made on a number of other fish populations. given the inferred importance of processes at the late larval and early juvenile stage, the Group felt that additional focus on these stages of the life cycle merit attention in a enlarged SARP.

30 Given the increases in understanding that have been generated on sardine and anchovy populations in upwelling systems is it possible to better define what time series should be institutionalized in the different

geographic areas? Given what we now know about sardine and anchovy systems what monitoring programmes would be useful for the study of the impacts of climate change on sardine and anchovy populations? The Group feels that some attention to the longer term trends in recruitment, in contrast to the inter-annual variability, should be part of the enlarged SARP.

31 The Guiding Group has specific comments on some of the "core questions for future SARP studies". In general they find the questions, to the degree that they address the questions of larval ecology, are comprehensive and address high priority issues. Questions n° 2 (How does the vertical migration behavior of larvae affect their advection and distribution?) and n° 8 (What are the relations between vertical migration behaviors of larvae, pray and predators?) are linked. The Group feels that these questions could be considered jointly. The Group does not feel that laboratory studies of gastric evacuation rates are necessarily required to address question n° 4. Field studies of stomach contents through the daily feeding cycle may suffice in certain situation. Finally the core questions do not appear to be well defined in relation to section XII of the report (implications of SARP for fishery management). For example the field programmes necessary to address most of the questions would be unlikely to be well design for the estimation of spawning stock size.

32 The Guiding Group of Experts, having reviewed the recommendations of the *ad hoc* Expert Consultation, recommends:

Broadening the conceptual framework by complementing the within-year experiment approach defined previously by the addition other process oriented recruitment research relevant to a comparative approach.

Ongoing recruitment research initiatives on Japanese sardine as well as the Mexican research an anchovies and sardines in the Gulf of California be included in SARP.

IOC should seek regional participation by OSLR in the new joint ICES/IOC Study Group on Models of Recruitment Processes to be held in May 1990 in Paris.

The development of close contact between IREP (and especially SARP activities) and those of the ICES Recruitment Processes Working Group by an increased level of participation by IREP representatives at the Working Group meetings.

3.1.2.3 IMARPE/GTZ/ICLARM Anchoveta Project

33 Dr. Daniel Pauly presented the key results of an on-going international multi-disciplinary project between IMARPE, GTZ and ICLARM on the "Peruvian anchoveta and its upwelling ecosystem: Three decades of changes".

34 The time-series that were assembled cover oceanography and meteorology (sea-surface and sub-surface temperature, upwelling and turbulence indices, incident solar radiation), population size of and anchoveta consumption by key predators (three species of guano birds, four species of fish, and two of seals), fishery biology data on the anchoveta (e.g. catches and their size composition, growth and egg production). The data assembled allowed derivation of other time series (e.g. new primary production size-structured monthly population estimates for 1953 to 1984) and quantification of important processes (e.g. anchoveta food consumption including cannibalism and density dependence of its growth, fisherman's non-compliance with fishery regulations, dissipation of economic rent in the Peruvian reduction fishery, etc.).

35 The results of the analysis of the initial set time series, 20 papers in all, were published in 1987 in a first book entitled "The Peruvian anchoveta and its upwelling ecosystem: Three decades of changes", Eds. D. Pauly and I. Tsukayama). A second book involving mainly analysis of derived

time series and a full synthesis of the overall project was published in 1989 (29 papers and 3 synthesis articles). The book is entitled "The Peruvian Upwelling Ecosystem: Dynamics and Interactions" edited by D. Pauly, P. Muck, J. Mendo and I. Tsukayama. The complete data set used in the analysis discussed in the two books is available on 14 diskettes:

Diskette	1:	Abiotic Factors
"	2:	Anchoveta Catch and Related Data
"	3:	Estimates of Anchoveta Biomass
"	4:	Data on Predators and Predation
"	5:	Anchoveta Egg Maps and Egg Mortality
"	6-10	Picture Files of Egg Maps
"	11-13	The Anchoveta Database
"	14	Anchoveta bibliography

These diskettes are available on request to ICLARM.

36 The final phase of the project involves the development of a simulation mode of the Peruvian anchoveta ecosystem which will have utility for fishery management. The modelling exercise is well advanced and will be completed in 1990. The third book of the project will present the simulation model. Publication is projected for 1991.

37 The Guiding Group of Experts endorsed the overall approach taken in this project. It demonstrates several unique features. First it attempted to make available all the relevant empirical observations that have been made in this ecosystem. The project has been extremely comprehensive. Second, it managed to provide credit to the scientists who have collected these data by encouraging them to publish papers in the first two books, but at the same time has made the accumulative data sets available to the broader scientific community for additional analyses. Third, the data sets themselves have been made available in diskette form. The Group felt that the approach used here could usefully be applied to other multi-disciplinary fisheries oceanography studies, for example for other upwelling ecosystems and the recently initiated cod/climate study in the North Atlantic.

3.1.3 Tropical Demersal Recruitment Project (TRODERP) Dynamics

3.1.3.1 TRODERP in the IOCARIBE Region

38 Dr. F. Robles, IOC Secretary for IOCARIBE, introduced this item and informed that to accelerate the implementation of TRODERP in the region (while attending the formalization of the IOCARIBE/TRODERP Group of Experts), the IOCARIBE Secretariat organized an *Ad hoc* meeting of regional experts in Cartagena, 19-21 May 1987 to follow up and formulate concrete proposals. Subprojects on Coral Reef Demersal Recruitment (CORDERP), Fish Estuarine-Deltaic Recruitment (FEDERP), and Penaeids Recruitment (PREP) were developed, taking into consideration priorities for regional demersal resources, potential interest of Member States and relevant knowledge and research capabilities.

39 More recently, a Workshop to define IOCARIBE-TRODERP Proposals was held in Caracas, Venezuela, 12-16 September 1989 to finalize the three Subproject Proposals. In addition, a Subproject on Satellite Ocean Analysis for Recruitment (SOAR) was completed, including actions supporting the other three Subprojects (Ref. Document IOCARIBE/WSA-TRODERP-I/3 Prov.).

40 During this Workshop, the work plan for each Subproject was completed, including the establishment of data bases and adoption of standard methodology for data collection, analysis and integration of results. Co-ordination mechanism with national technical committees were also recommended.

(i) <u>Satellite Ocean Analysis for Recruitment (SOAR)</u>

41 In consideration that this Subproject was a new one (e.g., not suggested in the Cartagena meeting of May 1987), a review of advantages for

using remote sensing to support the other three proposals was made. Additional information are presented under item 3.1.5 of this Report. Actions to initiate the Subproject were also identified, among them a co-operative initial effort of two years between institutions located in the south and north of the Wider Caribbean region (Simon Bolivar University, Venezuela and Texas A & M, USA, respectively).

42 The objectives of the Subproject at the pilot and regional levels, are:

(a) Analysis of relationship between the physical environment and its variability (specially at the inter-annual scale) and recruitment, using parameters collected through satellite remote sensing.

(b) Analysis of effects of physical events on behavior and survival of larvae, juveniles and adults, focusing and sexual maturity and spawning areas.

(c) Provision of larval drift trajectories for use by the other three IOCARIBE/TRODERP subprojects. For the other three Subprojects, in addition to specific elements proposed during the Cartagena meeting, working research hypotheses were further defined and specific objectives listed.

(ii) Fish-Estuarine Deltaic recruitment Subproject (FEDERP)

43 The following specific objectives for FEDERP were recommended:

(a) Ecosystem Processes; (dynamic characterization of physical, geomorphological and hydrological processes and characterization of nutrient dynamics, primary production and spatial and temporal variation of organic matter).

(b) Fishery Resources; (patterns of association of major populations of fishery resources and fish-habitat affinities; patterns of distribution and abundance of functional groups in different states of their life cycle; analysis for selected species in each functional group of reproductive and tropho-dynamics, growth, mortality, migration and biomass and density variability and "critical habitats" for each selected species in each functional group). The information generated would support projection of impacts of various types of habitat alterations within estuarine systems.

(iii) Penaeids Recruitment Subprojects (PREP)

44 This initiative in the IOCARIBE region is the direct outcome of the interaction within OSLR/IREP of scientists from the WESTPAC and IOCARIBE regions. The inferential framework and design is intended to follow that of the WESTPAC/PREP project (see item 3.1.3.2 of this Report).

45 The specific objectives of this Subproject are:

(a) Define bio-ecological aspects of penaeid shrimps species with important commercial value (life cycles, recruitment processes, interannual correlations between selective environmental and biological parameters and appropriate recruitment indexes).

(b) Develop environmental stock-recruitment models for predicting recruitment variability induced by changes of fishery exploitation and environmental/biological effects.

(c) Define the importance of artisanal and industrial fisheries in terms of catches, efforts and socio-economical benefits, as well as their impacts on the fishery resource itself and the environment. The informational framework and design is intended

generally to follow that of the WESTPAC PREP project (item 3.1.3.2 of this report).

(iv) Coral-Reef Demersal Recruitment Subproject (CORDERP)

Planned and on-going activities in this Subproject include the following:

(a) Describe the population genetics of spiny lobsters and four species of snapper throughout the Caribbean coral reef biotope.

(b) Perform fishery biological studies of the species most representatives in this ecosystem.

(c) Determine physical processes and biological interaction within the ecosystem and in artificial reefs.

A network of biological stations, national parks, etc., throughout the Caribbean would provide spatial coverage in sampling of newly settled juvenile fish and lobsters. Methodological innovations would include use of daily marks on otoliths to determine birthdate and data of settlement, and population differentiation through the analysis of mitochondrial DNA. These high quality data sets could in turn be integrated with the flow information produced under the SOAR Subproject to provide insight on the mechanisms of larval supply. This protocol would develop a store of inferential material with which to progress on the key questions of variability in recruitment and appropriate spatial scales for resource management.

The Guiding Group noted with satisfaction the progress made with TRODERP in the IOCARIBE region and **endorsed** the actions being implemented through the four subprojects proposed.

3.1.3.2 PREP in the WESTPAC Region

The Penaeid Recruitment Project (PREP) is a joint IOC-FAO collaborative research project aimed at promoting better management-orientated research on the commercially important penaeid prawn resources throughout the Indo-west Pacific region. The project uses a geographic comparative approach to enhance our understanding of the effects of fishing and environmental impacts on prawn stocks, as a means of providing better management advice within each participating country. The institutional framework for the project is based on a network of penaeid prawn researchers from Australia, Indonesia, Malaysia, Papua New Guinea, the Philippines and Thailand.

An IOC-FAO Workshop on Recruitment of Penaeid Prawns in the Indo-west Pacific Region (CSIRO Marine Laboratories, Cleveland, Australia, 24-30 July 1988) was sponsored by the Australian International Development Assistance Bureau (AIDAB), the Australian Fisheries Services (AFS), IOC, FAO and the South-east Asian Fisheries Development Center (SEAFDEC). Attended by 20 participants from Australia, Indonesia, Malaysia, Papua New Guinea, Philippines and Thailand, the workshop examined historical data sets across the region, selected species and study sites, and the type of scientific data to be collected. The report of the workshop, which includes individual country reports, was published by the as IOC Workshop Report no. 56. Preliminary data analysis which identified varying patterns of recruitment, associated with seasonality of rainfall, lead to a paper by Drs. Staples and Rothlisberg entitled "Recruitment of penaeid prawns in the Indo-west Pacific" was presented by Dr. Staples at the Second Asian Fisheries Forum in Tokyo in April 1988 and will be published in the 1990 Proceedings.

The Second IOC-FAO Workshop on recruitment of Penaeid Prawns was held in Phuket, Thailand, 25 - 29 September 1989. The Workshop, hosted by the Thailand Department of Fisheries, was sponsored by the Government of Thailand, IOC, FAO and the Australian Department of Industry, Technology and Commerce (DITAC). It was attended by 16 scientists from the above countries with the

addition of China. The Workshop was also attended by two prawn researchers from Mexico and Spain to strengthen inter-regional exchange of experience and involvement. The Workshop reviewed data collected over the past 12 months and examined methods of larval and post-larval identification, and standardization of data collection and storage. In addition, a study to test an hypothesis of the effect of rainfall on penaeid emigration (REX) was formulated. After the Workshop a National Co-ordinator Meeting was held (30 September 1989). To strengthen the PREP initiative in each country it was resolved that the PREP Technical Co-ordinator should visit the region early in 1990 to advise on data collection and storage problems; training on larval and post-larval should be undertaken at the CSIRO Cleveland Marine Laboratories; equipment purchases (e.g. personal computers and electrophoretic laboratory equipment) should begin. All of the above steps would be enhanced if the IOC-FAO PREP initiative attained a more prominent official status within each country.

52 The Guiding Group of Experts was particularly impressed by the detailed knowledge available on the Australian prawn resources, a study case that has allowed the development of a very successful research strategy and methodology. Conceptually this strategy is based on a complete description of the life history and timing of the different events throughout the annual cycle. Matches, mismatches and omission of certain events in different stocks and environments provide additional inferential power in the context of the comparative method. A detailed description of this methodology and of the project itself was distributed among the Guiding Group members.

53 Recognizing with great satisfaction the successful implementation of the PREP-WESTPAC initiative, **the GGE endorsed** the recommendations of the National Co-ordinators Meeting.

3.1.4 Recruitment Studies in the Context of Multispecies Dynamics

54 The "recruitment problem" (i.e. indeterminate relationship between recruitment and spawning biomass and environmental factors) is closely related to multispecies interactions between fish. There is the potential for the inter-species competition of food or space between early life history stage fish, and for prediction on pre-recruits by larger fish of another species.

55 The effect of multispecies predation among the fish community has been quantified for several regions ; e.g. East Bering Sea, Georges Bank, North Sea, off Peru. In each case, it appears that fish consume most of their own production, including a significant proportion of pre-recruits. This is one of the reasons that commulative pre-recruit mortality is very high, which make recruitment variability likely. Predation by fish is a likely cause of high pre-recruit mortality during all pre-recruit stages. This means that recruitment may not be determined until late in the pre-recruit phase (i.e. during the juvenile stage).

56 In one case, there is sufficient data to take into account of interannual variability in predation mortality on pre-recruits and its effect on recruitment. The ICES Multispecies Assessment Working Group has applied a method known as Multispecies Virtual Population Analysis (MSVPA) to North sea fisheries. MSVPA indicates that the instantaneous pre-recruit predation mortality exceeds 10 (per year) for several species, and that estimates of recruitment are much higher when predation mortality is taken into account. But the new estimates of recruitment are well correlated with previous estimates which implies that MSVPA does not account for recruitment variability. This is not surprising since to date MSVPA has only bee applied to late yearling (generally six months) or other fish. This may be after year-class strength has been established. It is likely that predation mortality is much higher for younger fish.

57 A forecasting version of MSVPA has been used by ICES to investigate the robustness of medium to long term multispecies management strategies with stockastic recruitment. In general, the strategies are robust so long as recruitment is modelled as a stationary process.

58 ICES intends to extend MSVPA to younger fish in order to better understand the effects of predation. There is also the possibility of applying MSVPA (or similar methods) to other areas (e.g. Georges Bank) in order to better understand the effect of predation by fish on recruitment.

59 ICES is also planning a theme session on "Trophic Models of Marine Ecosystems: Construction and Comparison" at its 1990 Statutory Meeting in Copenhagen. These models should provide further insight on the significance of predation of fish particularly pre-recruits) by fish. The Theme Session is also relevant to the "Ecosystems Dynamics for Living Resources" component of OSLR (discussed elsewhere) which places emphasis on synthesis of expected data into ecosystem models and the comparative method.

60 The Guiding Group of experts was pleased by recent progress in qualifying the effects of fish predation on recruitment. It recognizes the close relationship between recruitment dynamics and multispecies interactions.

3.1.5 Satellite Ocean Analysis for Recruitment (SOAR)

61 The IOCARIBE Workshop to define TRODERP Proposals (Caracas, September 1989) presented a proposal for a separate component (SOAR) which could provide necessary larval advection pattern input to each of the other three proposed components (see item 3.1.2). The newly-developed technology of "vectoring" satellite-sensed ocean surface features to produce useable flow fields was regarded as a methodological breakthrough for recruitment research in tropical demersal systems.

62 A presentation on SOAR at the *ad hoc* Expert Consultation on SARP (La Jolla, November 1989) produced enthusiasm, additional support, and requests for information and research assistance. The Group advised that the SOAR concept be extended beyond the confines of IOCARIBE TRODERP so as to be readily accessible to all IREP activities.

63 The Guiding Group of Experts recognizes that SOAR is potentially applicable even beyond IREP (i.e., to Harmful Algal Blooms, and Ecosystem Dynamics in Relation to Living Resources). The capability to derive sub-mesoscale resolution environmental information from routinely sensed unframed imagery is of particular interest. The opinion of the Guiding Group is that designation of any specific organizational component for SOAR would be less useful than promoting action on SOAR across project lines leading to promotion of training and technology transfer activities (TEMA) and incorporation of SOAR activities within specific regional projects.

64 As an example of the types of activities already underway in ocean applications of satellite technology, the Guiding Group of experts received a report by Dr. S. N. Dwivedi on activities on ocean remote sensing underway and proposed in India, including a proposed national workshop on satellite measurements, algorithm development, microwave sensing and applications to marine fisheries, water quality, coastal processes, wetlands management etc. and encouraged development of a high quality science programme.

65 Dr. Andrew Vastano, Texas AIW University (TAMU) presented a summary of satellite applications to fisheries recruitment in the Gulf of Mexico (Brown Shrimp) and Gulf of Alaska (Walleye Pollock) by the TAMU SOAR Group. A spring Penaeid recruitment field experiment that will be carried out by TAMU SOAR was reviewed and noted as a US national contribution that constitutes the initial IOCARIBE/PREP activity.

66 The Guiding Group of Experts considered the further development of the specific SOAR methodologies to be a high priority within OSLR. As an initial step in promoting activities in this direction, implementation of a workshop is recommended with a focus on the SOAR techniques and applications for satellite analyses of larval drift trajectories, larval retention and characteristics of the associated physical ocean features and processes.

3.1.6 IOC-SCOR Workshop on the Statistical Analysis of Recruitment Time Series Variability

67 Recommendation 8 of the Second Session of the OSLR Guiding Group of Experts (Rome, 1987) was "That IOC, in collaboration with SCOR, organize an expert consultation on the statistical analysis of recruitment time-series and arrange for the preparation of a handbook on basic techniques." This was accomplished in a meeting hosted at the Pacific Fisheries Environmental Group (Southwest Fisheries center, NMFS, NOAA) in Monterey California in August, 1989. Dr. Roy Mendelssohn was convenor and Chairman of the Meeting. Attendees included Experts in both the fields of statistical analysis and fishery biology.

68 The consensus of the meeting was that an encyclopedic work would be less useful than a more limited focus on a smaller set of potentially powerful new techniques, that are already finding their way into the fisheries literature, but are not widely understood and utilized throughout the fisheries scientific community. The aspect of the extremely small samples normally available for recruitment time series work was afforded particular attention.

69 An outline for a handbook was prepared. A unifying aspect for the several chapters is that several common data sets be designated as examples to be used where possible to demonstrate the power, and, particularly, the limitations of each method. Specific chapters, and the authors who have agreed to contribute them, are as follows:

I	Introduction
II	Data sets
III	Robust Methods (C.Field, Dalhousie Univ.)
IV	Bootstrap Estimates (M. Martin, Stanford Univ.)
V	Non-linear Non parametric Techniques (R. Mendelssohn, PFEG)
VI	Within and Between Groups of Species (K. Thomson, Dalhousie Univ.)
VII	Time Series Analysis: Small Sample Methods (R. Shumay, Univ. California, Davis).

70 A first draft of the handbook is expected in Autumn 1990.

3.1.7 Activities under the Intercommittee Recruitment Group and the Working Group on Recruitment Processes of ICES

3.1.7.1 A General Overview of Activities

71 The International Council for Exploration of the Sea (ICES) has a long history of recruitment research. ICES was invited to participate in the IREP component of OSLR in 1984. In response, ICES convened an IREP Study Group, which was followed by the IREP Steering Group of ICES. At present, ICES recruitment research is under the purview of the ICES Intercommittee Recruitment Group (IRG), whose chairperson serves as a member of the OSLR Guiding Group of Experts. The first report of the IRG (ICES C.M. 1989/A:8) was presented to the Guiding Group. The most recent report of the ICES Working Group on Larval Fish Ecology (ICES C.M. 1989/L:22) was also noted. Recently, the Working Group on Larval Fish Ecology was renamed the Recruitment Processes WG.

72 There are about twenty five identifiable recruitment research projects being conducted in the ICES area. These studies involve several species (e.g., cod, haddock, sole, mackerel, herring, sprat) and they address a variety of mechanism that might govern recruitment (e.g., starvation, predation, advection). They include field sampling, laboratory prediction experiments, mesocosm studies and modelling. Some of these studies apply the strategy formulated by OSLR.IREP for SARP. There will be a Theme Session on SARP at the 1991 ICES Statutory Meeting in La Rochelle.

73 Much progress is being made, in part, due to new methods of ageing from otolith microstructure, new indices of nutritional state of larvae, and

capability to sample on finer spatial and temporal scales.

74 Simultaneously with advances in understanding of the processes that cause variability in recruitment, ICES scientists have begun a re-evaluation of the objectives for recruitment research. The most frequently stated objective is to predict annual recruitment. In many cases, the processes that determine recruitment may be so complex that prediction may not be realistic in foreseeable future. Pre-recruit surveys are often a feasible alternative as a basis of short-term management discussions.

75 An alternative objective is to understand the factors that stabilize recruitment, in spite of fluctuating environmental factors that cause variability. Research on stabilizing mechanisms (i.e., compensatory processes that depend on the density of pre-recruits or of spawners) could improve medium to long-term management strategies. Sustainable yield theory depends on the existence of compensatory processes, which are generally presumed to occur during the pre-recruitment phase. At present, compensation is difficult to quantify.

76 One school of thought is that it is necessary to understand the factors that cause variability, so that variability can be filtered out, in order to quantify the relationship between spawners and recruits stock/recruitment relationships. It is not clear that accounting for variability will necessarily permit quantification of the S/R relationship.

77 Another objective of recruitment research is to anticipate long-term changes in recruitment patterns that may be caused by climate change, or to explain persistence patterns (trends or long period changes) in historical recruitment. It is important to distinguish between climate, overfishing or habitat alteration as the cause.

78 Regardless of the objectives of recruitment research, it should be recognized that it involves all pre-recruit life stages, and the processes that regulate egg production and egg quality. In general, it will be insufficient to limit studies to larvae.

79 ICES has also recognized a need to improve the conceptual basis of recruitment research through more diverse models. Some of the conceptual issues are (i) the interaction between environmental factors and density dependent population regulation; (ii) relationship between predation and starvation; (iii) propagation of variability (both real and measurement error) when integrating over time and space scales; (iv) role of genetics and; (v) limits of predictability.

80 ICES plans to convene a meeting of a Study Group on Modelling of Recruitment Processes in May 1990 under the Chairmanship of John Pope. IOC has agreed to co-sponsor the meeting and host it at IOC Headquarters in Paris. There will be a mini-symposium on Models of Recruitment Process at the 1991 Statutory Meeting in France.

81 The ICES Recruitment Processes Working Group also plans to meet in Nantes, France, June 1990. The Working Group will discuss planning of an international recruitment research project in the ICES area. While ICES nations have benefitted by co-operating in the past, there is a believe that a true international effort, from the planning stage onward, is necessary to make more rapid progress.

82 ICES is also planning a five year study of cod recruitment in relationship to environment for six major fishing areas across the North Atlantic. Arguably, there are the best databases for these populations and this region available anywhere in the world. Therefore, it is a good opportunity for a rigorous comparative study (see below Cod and Climate Project (CAC) of ICES).

83 The Guiding Group was interested to learn about the progress of recruitment research in the ICES area and with improved co-operation between

ICES and IOC on recruitment research. The co-sponsorship of the Study Group on Models of Recruitment Processes is a good example. The Guiding Group is encouraged by the routine exchange of observers between ICES and OSLR. It also noted the valuable contribution of the chairperson of the ICES Working Group on Recruitment Processes to the *Ad hoc* Consultation on SARP.

84 The Guiding Group endorsed the application of the comparative method, which is a key element of IREP, to the investigation of North Atlantic cod. The Guiding Group believes it would be beneficial for ICES scientists participating in the North Atlantic cod study to make the databases readily available to the worldwide scientific community (e.g., floppy disks). The synthesis of information on the Peruvian Upwelling System (Pauly et al, 1989) demonstrates the feasibility and benefits of making databases readily available.

85 The Guiding Group noted that the ICES Working Group on Recruitment Processes may issue a Newsletter on recruitment research. The Guiding Group recommends close co-ordination between the ICES Newsletter and the OSLR Newsletter that will be initiated in the near future.

3.1.7.2 Cod and Climate Project (CAC) of ICES

86 R. J. H. Beverton reported on this project, which originated at the 1989 ICES Statutory Meeting, from the initiative of B.J. Rothschild and S. Sundby. A Study Group has been set up under the Chairmanship of S. Sundby. A preparatory meeting was held at the Marine Research Institute, Bergen, from 16-18 January which R. Beverton attended on behalf of IOC. The definitive report of this meeting is not yet available but will be forwarded to IOC as soon as possible. This statement is therefore his personal impressions only.

87 Cod stocks and fisheries have already provided valuable clues about the role of environmental factors. The aim of CAC is to use the wide environmental range of the many distinct cod populations around the N. Atlantic margin and the wealth of biological, oceanographic and historical data pertaining to them, to establish more definitive conclusions. as the basis for assessment of the likely effects of future climate change.

88 The CAC project is conceived as a multi-disciplinary, multi-institute, inter-disciplinary exercise on a 5-year time-scale. It is intended to link with developments in Ocean Climate Programmes (eg WOCE) for the physical input.

89 Conceptually, CAC will take a broad sweep in space and time. It will cover the whole life-cycle of the cod and give special attention to factors governing population control and persistence, and to the extension and contraction of environmental range, as well as to changes in abundance. "Recruitment processes" in the conventional , short-term, sense are therefore part, but only part, of the exercise; long term trends and major shifts in stable (or quasi-stable) states will be given as much or greater prominence.

90 Operationally, the central aim is to set up parallel, interlocking sub-models of the physical environment and cod population biology at several (at least 3) spatial/temporal levels, e.g.

Physical	**Biological**
Ocean Basin-decadal	Zoo-geographical range
Regional-years	Total Life-cycle dynamics
Local-weeks	Spawning and larval production

91 In building up these hierarchical models, a number of research projects are envisaged ; examples include :

(i) Responses of cod stocks/fisheries to historical climate change on time-scales of decades/centuries, using surrogate data where necessary;

(ii) Analysis of consistency of location and timing of cod spawning in relation to environmental factors, notably the Calanus outburst; and

(iii) Experimental investigation of the population physiology of cod larvae/juveniles from genetically distinct stocks in similar/different parts of the species range.

92 Fundamental to the CAC Project is the compilation of a comprehensive data set covering both biological and physical aspects. Details are still to be worked out.

93 It is intended that the Sundby Study Group will proceed mainly by correspondence, but it is envisaged that a second meeting will be necessary in the early summer to draw up more definitive plans.

3.1.8 Recruitment Studies on Squid

94 The Guiding Group of Experts considered the prospects of an OSLR/IREP project on squid recruitment. Squid fisheries are important worldwide and there is the potential for expansion in some regions. Because of their short life cycle (usually one year), the fisheries are almost totally dependent on annual recruitment, which is currently unpredictable.

95 The need to better understand the factors that control squid recruitment is clear. In general the life history of squid populations is poorly understood, particularly for oceanic species that are the most likely candidates for an international project; In many cases, spawning grounds and the taxonomy of early life stages are unknown. The Guiding Group noted that there are symposia planned for 1990-1991 in Japan and Canada that may provide new insight on squid. Therefore the Guiding Group decided to postpone action on a squid recruitment project.

96 The Chairman of the GGE reported that all recommendations adopted in previous meetings in relation to squid recruitment were implemented. Support was also made available by FAO for the edition of a review on squid data related to recruitment. These series of actions aroused considerable interest among scientists in this field and opportunities for further progress do exist, particularly in connection with squid fisheries and their management (for example South West Atlantic). It is requested that FAO and IOC consider the support of participants from developing countries in the symposia to be held in Japan and Canada during 1990-1991.

3.1.9 OSLR Activities in the Mediterranean

97 The Guiding Group of Experts noted the efforts made to promote the active participation of the Mediterranean sea countries in OSLR activities, particularly within the context of the FAO General Fisheries Council for the Mediterranean (GFCM) and the IOC-UNESCO co-sponsored multinational research programme on Physical Oceanography in the Eastern Mediterranean (POEM). As part of these efforts, the Chairman of the Guiding Group of Experts and the IOC Technical Secretary for OSLR gave a lecture on "Fishery Science and Oceanographic Research in the Mediterranean" at the XIX Session of the GFCM, held in Livorno, Italy, 27 February - 3 March 1989. At this session, the Council requested the Secretariat to approach the Intergovernmental Oceanographic Commission (IOC/UNESCO), the International Maritime Organization (IMO), the United Nations Environment Programme (UNEP) co-ordinating Unit for the Mediterranean Action Plan, the European Economic Community (EEC), the International Commission for the Scientific Exploration of the Mediterranean Sea (ICSEM) to ascertain their interest for a meeting on long term trends and the interactions of fisheries with the environment in the GFCM area, where due consideration would be given to the activities within the IOC-FAO/OSLR Programme. As a result of these consultations, a GFCM meeting on long-term change is being convened the 16-17 May 1990. Besides that on long-term trends and changes in fisheries, the GFCM member countries expressed significant interest in OSLR activities, particularly in SARP and in harmful algal blooms.

3.1.10 USSR Recruitment Surveys

98 A short review on extensive recruitment surveys realized in the Soviet Union for the last three decades was presented. The main purposes of these investigations were:

(i) to reveal the spawning grounds position, drift patterns and nursery grounds of abundant food fish in the North Atlantic;

(ii) to estimate spawning stock size of herring, cod, haddock, capelin and catfish on the basis of ichthyoplankton studies; and

(iii) to assess the strength of year-classes by means of rate, larval and juvenile surveys.

99 In the North West Pacific extensive ichthyoplankton surveys were carried out to identify spawning grounds, stock discrimination, time of spawning, stock assessment and strength of the year classes in Walleye pollock, pacific sardine, herring and saury.

100 The population fecundity concept, as reproduction capacity estimator, was tested to obtain three levels of spawning stock size - safe, minimal required and critical - to produce abundant year-class in favourable ambient conditions.

101 The desire to organize an international recruitment project in the Black Sea was mentioned.

102 The Guiding Group of Experts was most interested in having these extensive USSR time series on survival index for a number of North Atlantic fish populations summarized. They incurred the broader distribution of this rich data set to other scientists working on recruitment studies of these populations.

3.1.11 CPPS International Symposium on Living Resources and Fisheries in the South-east Pacific

103 The Guiding Group of Experts noted the success achieved by the International Symposium on Living Resources and Fisheries in the South-east Pacific, organized by the Permanent Commission for the South-east Pacific (CPPS) in Vina del Mar, Chile, 9-13 May 1988 with the co-sponsorship of, amongst others, the FAO and IOC, as part of their efforts to support OSLR related regional activities. More than 150 papers were presented at the Symposium, which was attended by scientists from 60 institutions from Latin America with some key participants from other countries around the world. Key lectures and scientific papers were presented at the Symposium by various members of the OSLR Guiding Group of Experts. The proceedings with a selection of the papers presented at the Symposium is now being prepared for publication by the CPPS.

3.2 THE NEW OSLR COMPONENT ON HARMFUL ALGAL BLOOMS (OSLR/HAB)

3.2.1 Summary of the Activities of the *ad hoc* Group of Experts on Harmful Algal Blooms

104 The OSLR *ad hoc* Group of Experts on Harmful Algal Blooms (GE/HAB) met in Paris, 31 January - 2 February 1990. The motivation for the meeting and for the establishment of an OSLR programme on this topic stems from the significant increases in human health and economic impacts from harmful algal blooms experienced by member states over the past several decades. There are many factors that account for this increase, one of which may be a global expansion in the frequency, magnitude, and distribution of harmful algal blooms, perhaps as a result of man's activities. While the GE/HAB concurred that eutrophication has clearly been accompanied by increasing harmful blooms in certain areas such as Hong Kong harbor or the Seto Inland Sea of Japan, many other outbreaks show no obvious links to pollution. A further

complication to programme formulation is that harmful algal blooms are caused by a wide variety of phytoplankton species spanning numerous classes or functional groups, such that no single set of growth or hydrographic conditions applies to all.

105 The GE/HAB began by compiling a list of "problems" that a global programme on harmful algal blooms should address. These include:

(i) There have been significant increases in economic losses and human health impacts due to harmful algal blooms throughout the world. Many scientists believe that this is due, in part, to an increase in the frequency, magnitude, and distribution of harmful algal blooms.

(ii) Most countries are poorly prepared to cope with the impact of these blooms on public health, tourism, existing fisheries and their future expansion. All coastal states are potentially at risk.

(iii) A predictive capability for harmful algal blooms is prevented by inadequate scientific understanding and lack of environmental data (both long and short-term).

(iv) Many current assay methodologies for toxins are inadequate for all regions due to geographic, financial, social, and technology constraints. A serious shortage of official toxin standards is a major impediment to monitoring and research.

(v) At present, research, monitoring, and management of harmful algal blooms and their impacts are largely regional concerns, with little or no international coordination or information exchange other than through conferences and published literature.

(vi) Medical treatments are symptomatic and antidotes are not available for algal toxins.

(vii) The possible relationship between harmful algal blooms and global environmental change should be investigated.

106 Many of these issues could be encompassed by 3 specific objectives:

(i) Build a comprehensive understanding of the scientific mechanisms underlying harmful algal blooms and their associated impacts.

(ii) Develop, evaluate, and disseminate monitoring and management strategies to assist regions affected by harmful algal blooms in reducing economic and public health impacts.

(iii) Develop training and information networks to transfer research and management knowledge to those regions presently or potentially at risk from harmful algal blooms.

107 Details of the programme that was then formulated will be presented in the GE/HAB formal report, but an outline of the major components is given in Table 1, with the expected benefits enclosed in parentheses. A fundamental component that addresses both the need to coordinate research, monitoring, and management activities and the need for information exchange is the establishment of a database and communication network among those working on harmful algal blooms. Refinement of these concepts and the creation of specific action plans will require additional working group meetings. The specific recommendations of the *ad hoc* Group of Experts on Harmful Algal Blooms are listed under Item 3.2.2.

TABLE 1. **PROGRAMME FORMULATION - HARMFUL ALGAL BLOOMS**

I. ECOLOGY

A. Eutrophication-related blooms

1. Advanced Intercalibration exercise (education, standardization)
2. Monitoring (network, education, standardization, management)
3. Experimental studies (research, education, management)

B. Blooms not related to eutrophication

1. Advanced intercalibration exercise (education, standardization)
2. Monitoring (network, education, standardization, management)
3. Projects
   - Pyrodinium in Indo-West Pacific (research, education)
   - Salmonid impact study (research, education, management)
   - Ciguatera and man's activities (research, management)
   - Time series analyses (research, management)
   - Methods manual (research, management)

II. TAXONOMY

1. Data base of reference slides, identification sheets, preserved samples, list of experts (network, standardization)
2. Invited working groups (standardization, education, manual)
3. Training workshops (education, standardization)
4. Culture collections (network, research)

III. TOXICOLOGY

1. Intercalibration exercises (standardization)
2. Training workshops (education, standardization)
3. Database (networks, management,research)

3.2.2 Recommendations of the *Ad hoc* Group of Experts on Harmful Algal Blooms

108 The OSLR *ad hoc* Group of Experts on Harmful Algal Blooms recommends :

(i) That studies of the incidences and causes of harmful algal blooms be developed and implemented by IOC in coordination with other agencies, particularly FAO.

(ii) That a group of experts on harmful algal blooms be established by IOC and co-sponsorship be solicited from other ICSPRO agencies in order to develop detailed design criteria to guide implementation of these projects.

(iii) That the IOC Secretariat ensure that a mechanism be established to coordinate activities among UN agencies relative to ongoing and future studies of harmful algal bloom phenomena.

(iv) That the initial development of a programme on harmful algal blooms focus on the following project areas:

a) The linkage between eutrophication and harmful algal blooms, explored by direct experimental approaches and regional monitoring.
b) A study of Pyrodinium distribution in the WESTPAC region.
c) A study of the mechanisms and impact of harmful algal blooms on salmonid aquaculture.

d) Time series analyses of harmful algal bloom occurrences in relation to climatic factors.
e) A study of the linkage between ciguatera and human activities.

(v) That actions be taken for the organization of an advanced intercalibration research and training workshop on harmful algal blooms.

(vi) That a strong training and education component be designated as an essential component of all harmful algal bloom programme activities. Travel funds for attendance at workshops and international conferences should be provided for participants from developing countries.

(vii) That the IOC Secretariat establish an information network with access to a data base and newsletter on harmful algal blooms.

(viii) That the IOC Secretariat advise member states to advocate continuation and promotion of monitoring programs (and analysis of existing long-term datasets) to aid in determining trends and in developing understanding of the mechanisms underlying the development and persistence of plankton components.

(ix) That the IOC bring to the attention of member states: a) that there is a critical shortage of toxin standards required for research and human health protection; b) that there is a need to increase the supply of toxin standards; and c) that there is a need to develop more selective and sensitive analytical techniques than those currently available for toxin detection and quantification.

(x) That the IOC stress to member states and other agencies the importance of culture collections to investigators of harmful algal blooms and urge increased support for their continuation and expansion, and establish a mechanism for coordination and exchange of cultures to better serve the needs of the research community.

(xi) That a manual be prepared describing standard methodologies for biology, toxicology, monitoring, and management of harmful algal bloom phenomena.

3.2.3 Discussion on the Report of the *ad hoc* Group of Experts on Harmful Algal Blooms

109 The OSLR Guiding Group of Experts (GGE) feels that harmful algal bloom phenomena represent a very important area of concern for member states that should be addressed by a coordinated global program. Given an increase in the public health and economic impacts of these problems in recent years and the potential that these changes reflect man's activities, efforts to develop a specific global programme should be initiated as soon as possible. The Guiding Group of Experts endorses the recommendations of the OSLR *ad hoc* Group of Experts of Harmful Algal Blooms, (listed under Item 3.2.2) with the following general comments:

(i) Accumulating evidence suggests that fundamental changes may be occurring in the phytoplankton species composition of many coastal areas, leading to increased impacts from harmful algal blooms. Direct proof that this change is actually occurring may never be possible, even with extensive data collection, yet the Guiding Group of Experts feels strongly that harmful algal blooms should be recognized to be one probable consequence of sustained coastal pollution.

(ii) Future Harmful Algal Bloom programme development should take advantage of expertise and activities of other intergovernmental

agencies. Examples would be taxonomic identification sheets for phytoplankton under development by ICES or attempts to establish a "bloom" database, also proposed within ICES. The chairman of the ICES Working Group on Phytoplankton and Management of Their Impacts should be present at future planning meetings of the Harmful Algal Bloom programme.

(iii) The development of a manual for algal bloom studies should be a useful mechanism for standardizing methodologies and disseminating information.

(iv) Access to a comprehensive database and centralized information network are important components central to the efficiency and effectiveness of the Harmful Algal Bloom Programme.

(v) Establishing, standardizing, and coordinating monitoring programmes should be a major emphasis within the Harmful Algal Bloom Programme. The countries and locations to be included in such a network and the parameters to be monitored need careful definition. The importance of physical mechanisms in the origin, aggregation and transport of blooms should not be neglected in such programmes and deserve further consideration.

4. COOPERATION WITH OTHER PROGRAMMES

4.1 INTERNATIONAL PROGRAMME FOR THE DYNAMICS AND OCEANOGRAPHY OF COASTAL AND SHELF SEAS AND EXCHANGES

110 **The Guiding Group of Experts for OSLR endorsed** the rationale put forward by the *ad hoc* Expert Consultation that the circulation and associated dynamic processes and forcing, and the exchanges between the open sea and shelf, are fundamental for the proper understanding of conditions in the transition zone from the land open seas.

111 **The Guiding Group of Experts considered** that in order to obtain full benefit out of this new initiative, close collaboration between both Programmes is vital and recommends the Secretary of IOC to take action in order to facilitate it.

112 **The Guiding Group of Experts noted,** however,:

(i) That a vast amount of research in coastal oceanography is already in progress.

(ii) For the IOC attempt to achieve even the first of the four phases set out in the Report of the *ad hoc* Group (Ref. IOC-XV/INF.769) would be a very demanding task.

(iii) If this initiative is to make advances in the foreseeable future which will offer any tangible support to other IOC programmes, as is claimed in the *ad hoc* Group's report, very sharp focussing of objectives, location and timing would be required.

(iv) This can be achieved only with the closest collaboration between the groups in question.

(v) This collaboration has so far been unsatisfactory and the Guiding Group recommends that the Secretary IOC, takes the necessary remedial action.

4.2 OTHER PROGRAMMES RELATED TO OSLR

4.2.1 The US Global Ocean Ecosystem Dynamics Programme (GLOBEC)

113 The Global Ocean Ecosystem Dynamics (GLOBEC) programme, a US

National Science Foundation (NSF) programme being planned by the US academic research community, was presented by Dr. Michael Sissenwine.

114 An overview of GLOBEC is published in EOS (Transactions, American Geophysical Union, 70(6):82-85, February 7, 1989).

115 GLOBEC responses to the realization that the environment of our planet is changing, and this will effect the biotic, including marine animals which in many cases are valuable renewable resources. GLOBEC is global in the sense that the issues it will address concern the entire planet. By developing new models and instruments, and improving understanding of fundamental processes, GLOBEC should provide results that are of global significance. It is also recognized that potentially complementary programmes are evolving in other ccuntries and internationally. By joining together, these programmes can collectively study ecosystem dynamics on a global scale.

116 GLOBEC is quickly evolving from the planning to the implementation stage. Within 1991, three types of modelling studies will be initiated including: (i) models to consider simplification of ecosystems by scaling, pooling and/or averaging and limits of predictability ; (ii) models of biological processes in idealized flows; and (iii) site specific models. Development of new instrumentation is also planned for the near future. In particular, a system for three dimensional profiling of zooplankton size (perhaps including ichtyoplankton) will be developed. It will combine acoustic techniques, advanced image processing and biotechnology. The most likely area for the first GLOBEC field activity is the North-Atlantic, but this decisions has not yet been finalized.

117 The Guiding Group agreed with GLOBEC's focus on research on ecosystem dynamics in order to better understand the potential effects of global change. In this regard GLOBEC is complementary to the proposal to expand OSLR to include a component on Ecosystem Dynamics and Living Resources (EDLR), which is discussed under Item 5.1. It is expected that there will be a formal collaboration between EDLR and GLOBEC and its US Federal Laboratory counterpart.

4.2.2 The USSR Programme on Integrated Studies and Monitoring of Marine Ecosystems Exposed to Anthropogenic Impact and Global Climatic Change (ECOMONOC)

118 Dr. A. Tsyban presented the subject. She pointed out that the main goal of the Programme ECOMONOC is the long-term studies of marine ecosystem dynamics in various geographical zones of the World Ocean and assessment of man-induced changes in marine ecosystems exposed to global climatic change. The tasks of the Programme include:

(i) Investigations of biogeochemical pollutant cycles and contaminants distribution mapping.

Being involved in biogeochemical cycles contaminants are subject to microbial and photochemical decomposition, sorption, bioaccumulation and complexation. The ecological consequences of their impact on marine ecosystems vary significantly depending on regional peculiarities and climatic conditions. Mapping of contaminants distribution fields especially in highly productive zones of the World Ocean acquires a special importance for the prediction of the ecological situation (including living resources) and planning "responses" to its change.

(ii) Assessment of the ecological consequences of the World Ocean Pollution in various geographical zones

It is the peculiarity of the ocean environment that the greatest change comes from the long-term exposure of marine organisms and

especially their early stages of ontogenesis to low pollution levels resulting in a gradual environment accumulation of contaminants and eventually in ecosystem degradation. Therefore, ecological studies in high seas, especially in bioproductive zones, acquire a special importance.

To assess the ecological consequences of marine environment contamination and identify anthropogenic effects against the background of natural variability it is necessary to conduct long-term observation of basic physical, chemical and biological processes.

(iii) Assessment of the assimilative capacity in the key regions of the World Ocean

The assimilative capacity of each specific marine ecosystem has a specific final value characterizing an objective property of the marine environment - its self-purification from various contaminants. The value can be determined on the basis of long-term interdisciplinary studies in the most thoroughly investigated regions of the Application of this concept envisages the solution of three main tasks:

a) quantification of balance disturbances and "lifetime" changes of contaminants in the ecosystem;
b) assessment of the biotic balance (production-destruction processes relation) and biomass of different groups of marine organisms;
c) determination of the "critical" concentrations of the contaminants effect upon different marine organisms and biological processes.

(iv) Investigation of carbon biogeochemical cycle elements in the ecosystems of the World Ocean and determination of its role in global climatic processes

Dr. A. Tsyban presented the key results of the Programme ECOMONOC which have been implemented in different seas (e.g.) Baltic, Bering seas, etc.) and in the central Pacific on a national level, within the framework of the USSR-USA co-operation, and other bilateral activities. The main results of long-term multidisciplinary investigations in different area of the World Ocean are available in the book "Anthropogenic ecology of the Ocean" by Yu. Izrael and A. Tsyban (Leningrad, Gydrometeoizdat, 1989, pp. 527).

Dr. A. Tsyban has proposed to extend these types of multidisciplinary research to other areas of the World Ocean and to include the Programme ECOMONOC into the activity of OSLR and to combine with the other on-going or planned programmes (such as US Programme GLOBEC) and relevant bodies of IGBP.

4.2.3 **Ecosystem Dynamics Initiative in Brazil (BICED)**

119 In order to understand the structure and dynamics of tropical coastal ecosystem, an integrated oceanographic investigation was started in 1985 by the University of Sao Paulo at coastal region near Ubastuba (24°S). During last four years, intensive sampling has been carried out in this region by the groups of researchers from different specialties. One of the objectives was to investigate an interaction among physical, chemical and biological components and to study energy flow int he coastal ecosystem. Many new findings on dynamics of ecosystem have been obtained until now and the project will be concluded at the end of 1990.

4.3 INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME (IGBP) AND PREDICTED GLOBAL CLIMATE CHANGES

The International Geosphere-Biosphere Programme: A study of global change (IGBP), attempts to describe and understand the interactive physical chemical and biological processes that regulate the total Earth system with particular emphasis on those that are most susceptible to human perturbation. Major global climatic changes are expected to take place in the next decades as the result of the accumulation of CO_2 and other greenhouse gases in the atmosphere.

Despite the success in modeling global climate, exact prognosis of these changes for the oceans interior is severely impaired because of the limited knowledge on some key oceanic physical and biological processes. However, in addition to these dynamic effects, the impact of climate change will alter the pattern of distribution of conservative properties and circulation of the world oceans.

A review of available results of coupled models of the ocean and atmosphere in response to an externally imposed change in atmospheric carbon dioxide was presented. After 50 years of the establishment of altered conditions in the atmosphere the following consequences could be observed:

(i) extensive warming of the surface layer of the ocean (500m);
(ii) changes in the surface pattern of distribution of temperature, salinity and circulation;
(iii) disruption of the normal pattern of meridional vertical circulation.

123 These changes would locally affect the biodynamic of production, dislocate coastal (and oceanic Island) habitats, expand/contract pelagic habitat and change the distributional pattern of marine populations. To an unknown extent, the marine biosphere could provide feed-back mechanisms for the climate that would exacerbate or diminish global change.

124 The Joint Global Oceans Flux Study (JGOFS) of the Scientific Committee on Oceanic Research, an independent component of IGBP, has focussed on the role of the oceans in regulating the climate system and its rate of change in response to the greenhouse effect.

125 On land, climate change will not only affect natural terrestrial ecosystems but also impose regional constraints on agriculture and forestry. These impacts are widely recognized and plans are currently been designed for predicting them and for identifying alternatives that will alleviate negative effects. However, prediction of the impacts of climate change on marine ecosystems have not received the attention they deserve, given the magnitude of the socio-economic consequences these changes will have on states which economies depend to a significant extent on the exploitation of marine resources.

126 In December 1988, during the IGBP Southern Hemisphere Workshop held in Mbabane, Swaziland, this issue was addressed on its own merits and several areas of research identified. In the Report of the meeting (IGBP Report No. 9 : "Southern Hemisphere Perspectives of Global Change: Scientific issues, research needs and proposed activities").

127 On June 1989 an *Ad hoc* meeting on potential IOC involvement in the oceanographic components of IGBP took place in Paris and drafted a resolution for consideration at Fifteenth Session of the IOC Assembly. This document was approved as Resolution XV-6.

128 The Guiding Group of Experts discussed several possibilities on how to implement this Resolution within the context of OSLR and agreed upon developing a new OSLR sub-programme (see 5. EDLR/OSLR), complementary to other ongoing initiatives (IREP, HAB), with the specific aim of providing a system overview, that through extensive use of the comparative method, would improve

the ability to predict the impact of climate change on living resources.

4.4 CONTINUOUS PLANKTON RECORDER PROGRAMME (CPR)

129 Dr. Sinclair gave a brief update on the funding proposal for the continuation of the Continuous Plankton Recorder Programme. There was a discussion on the requirement for evaluating any bias that may be introduced into the results from the programme due to the recorder being towed at a fixed depth of 10 meters. It was also pointed out that greater access to the data by the broader scientific community should be facilitated. The Group highlighted the critical importance of the time series data from this unique plankton monitoring programme. The programme is of particular interest in the analysis of the impacts of changes in ocean climate at large time and space scales. Its potential usefulness in other oceans was discussed. The Chairman informed the Group that he had written to Dr. Woods, the head of the British science organization that has been funding the CPR, to urge that the CPR be continued. The Guiding Group of experts fully supports the CPR Programme and urges member countries of IOC from the North Atlantic area to provide financial support to ensure its continuation and elaboration.

5. REQUIREMENTS FOR ONGOING AND PLANNED ACTIVITIES

5.1 ECOSYSTEMS DYNAMICS IN RELATION TO LIVING RESOURCES (EDLR)

130 Following the presentation of IGBP and other new integrated research programmes such as GLOBEC and ECOMONOC, the Guiding Group of Experts analyzed the possibility of initiating a new stream of research within OSLR with the specific aim of developing a strategy and methodology to assess the potential impact of global climate change over marine resources and ecosystems.

131 After considering: (i) the success of IREP in following a well defined and highly focused strategy for looking at recruitment processes; (ii) the potential of the comparative method as developed within IREP, to increase insight on complex processes in a very cost-effective way; (iii) the fact that knowledge on several fundamental aspects of marine ecosystem dynamics is unbalanced and incomplete; (iv) the implications of starting a new initiative within OSLR, that because of its global and multidisciplinary nature could, overextend IOC's resources and capacities creating unwarranted expectations among Countries Members; (v) the urgent need to respond effectively to the challenge of assessing the Impact of Climate Change over marine resources and ecosystems.

132 The Guiding Group of Experts came to a consensus that steps should be taken to establish a new Sub-programme on "ECOSYSTEMS DYNAMICS IN RELATION TO LIVING RESOURCES" with the purpose of developing a system overview of several marine ecosystem, with particular emphasis in those which main biotic components are renewable resources.

133 At this stage, the group identified as the most fruitful strategy in this area a comparative modelling exercise that by applying a reduced but similar set of models to several systems, could provide valuable insights on their dynamics, detecting crucial gaps of knowledge and information.

134 New approaches derived from theoretical ecology have been shown to be capably of extracting large amounts of information from steady-state multispecies trophic models and enable straightforward quantification of the degree of organization of ecosystems, i.e., their complexity and maturity.

135 The suggested modelling exercise should be preferentially applied to systems that have the potential for developing a generic coupled process model on the basis of the high level of commonality of the oceanographic and ecological process structuring them.

136 As part of this effort, special priority should be given to the

study of single process models, that being nested sub-systems of the generic one, would lend themselves to conducting sensitivity analyses in response to predicted global climatic changes. In this latter context, some of the processes that could be considered are:

(i) changes in the production regimes in response to the expected changes of physical forcing such as wind stress patterns, ocean circulation, increased input of nutrients and higher temperature regime;

(ii) changes of food web structure in response to exploitation and other stresses (e.g., pollutants, temperature increases, etc.); and

(iii) distributional changes of key species and their early life history stages.

137 Given the wide scope of this new sub-programme, it is recommended that a special workshop be convened to formulate more detailed terms of reference.

5.2 INTER-REGIONAL EXPANSION OF OSLR ACTIVITIES

138 The development of OSLR/IREP has been largely pursued through the establishment of specific regional pilot projects. these were designed to demonstrate the effectiveness of the conceptual approach, feasibility of the operational design, etc. Now that OSLR has been in existence for some years, the question of expansion to other regional settings must be addressed.

139 For example, certain countries of the Indian Ocean and the IOCEA region have expressed strong interest in OSLR and have indicated a desire for establishment of OSLR activities. Many of these countries presently have national programmes which might be grouped together to form regional OSLR-IREP components. Small pelagic fishes (sardines and mackerels) and prawns are of great importance to the fishing industries of these regions. Thus SARP and TRODERP-PREP projects could be of great interest.

140 The means to expand rapidly and effectively OSLR activities in this and other regions may be unavailable. This is particularly true for the near future where OSLR may lack a Technical Secretary at IOC. However, the feasibility of establishing pilot projects and activities should be researched and pursued. In any case, dissemination of information and vigorous support for training and development (TEMA) activities should be sought. General familiarization with OSLR research philosophies and project designs should be provided through participation of OSLR experts and IOC-FAO technical staff at regional workshops and symposia.

5.3 OSLR NEWSLETTER

141 The IOC Assembly decided, during its Fourteenth Session, that an OSLR Newsletter be established, and this became Recommendation No. 10 of the Second Session of the GGE. In this Third Session of the GGE, the Group noted, upon examination of the role and impact of OSLR throughout the world, that the continued lack of a Newsletter has now become a major impediment to the cohesiveness of identity of the OSLR Programme, and a factor limiting its expansion in developing countries. Different formula for a Newsletter were discussed, with some emphasis on the perceived need to prevent overlap with similar efforts, notably with the Recruitment Newsletter of ICES, and to prevent the components of OSLR (i.e. the IREP, the Harmful Blooms activity, the proposed EDLR project) to isolate themselves from each other.

142 The consensus which emerged was that OSLR should produce its own Newsletter called **"Ocean Science and Living Resources"**, which should cover the whole breadth of the OSLR activities, but which could include flyers or distinct pages devoted to specific projects within OSLR.

143 Dr. Patricio Bernal, a member of the GGE, volunteered to act as founding editor of the Newsletter and the GGE welcomed this offer, noting that his scientific standing with both the communities of physical and biological oceanographers would be a considerable asset in attracting contributions for the first issues of the Newsletter.

144 The GGE was unable to identify all logistical aspects of the production of the Newsletter; however, the following items were felt to be important:

(i) the Newsletter should be produced, printed and distributed from the editor's city of residence;

(ii) the Newsletter should be produced using desktop publishing technology (using appropriate software and a laser printer), have an attractive layout, be printed in offset on good quality paper and have coloured logos (IOC, FAO) on the cover page; and

(iii) the cost of production of the Newsletter will include the following elements:

a) the editor's time (voluntary contribution),
b) hardware (on IBM or compatible microcomputer with an EGA or compatible graphic card, and one laser printer),
c) printing and mailing of 2-3 issues per year (20 pages each); number of copies to depend on intended mailing list which could be assembled from IOC, FAO, ICES, TOGA, ICLARM and other related mailing lists.

6. ELECTION OF OFFICERS OF THE GUIDING GROUP

145 A. Bakun and P. Bernal were re-elected as Chairman and Vice-chairman of the Guiding Group. As well it was suggested that the Secretary of IOC re-evaluate the appropriate structure for guiding groups of experts for the diverse components of the OSLR, the present Guiding Group of Experts being predominantly drawn from the fisheries oceanography research community.

7. DATES AND PLACES OF THE FOURTH SESSION OF THE GUIDING GROUP

146 No dates or location were selected for the next meeting of the Guiding Group.

8. ADOPTION OF THE SUMMARY REPORT AND RECOMMENDATIONS OF THE SESSION

147 The Guiding Group adopted the Summary Report and the Recommendations (Annex II, hereto).

9. CLOSURE

148 The meeting was closed by the Chairman at 17h00, on Friday 9 February 1990.

ANNEX I

AGENDA

1. OPENING

2. ADMINISTRATIVE ARRANGEMENTS

2.1 ADOPTION OF THE AGENDA
2.2 DESIGNATION OF RAPPORTEUR
2.3 CONDUCT OF THE SESSION, TIME TABLE AND DOCUMENTATION

3. REVIEW OF INTERSESSIONAL ACTIVITIES

3.1 INTERNATIONAL RECRUITMENT PROGRAMME (IREP)
- 3.1.1 General Overview of the Programme
- 3.1.2 Sardine/Anchovy Recruitment Project (SARP)
  - 3.1.2.1 Summary of Intersessional Activities
  - 3.1.2.2 *Ad hoc* Expert Consultation on SARP
  - 3.1.2.3 IMARPE/GTZ/ICLARM Anchoveta Project
- 3.1.3 Tropical Demersal Recruitment Project (TRODERP) Dynamics
  - 3.1.3.1 TRODERP in the IOCARIBE Region
  - 3.1.3.2 PREP in the WESTPACT Region
- 3.1.4 Recruitment Studies in the Context of Multispecies Dynamics
- 3.1.5 Satellite Ocean Analysis for Recruitment (SOAR)
- 3.1.6 IOC-SCOR Workshop on the Statistical Analysis of Recruitment Time Series Variability
- 3.1.7 Activities under the Intercommittee Recruitment Group and the Working Group on Recruitment Processes of ICES
  - 3.1.7.1 A General Overview of Activities
  - 3.1.7.2 Cod and Climate Project (CAC) of ICES
- 3.1.8 Recruitment Studies on Squid
- 3.1.9 OSLR Activities in the Mediterranean
- 3.1.10 USSR Recruitment Surveys
- 3.1.11 CPPS International Symposium on Living Resources and Fisheries in the South-east Pacific

3.2 THE NEW OSLR COMPONENT ON HARMFUL ALGAL BLOOMS (OSLR/HAB)
- 3.2.1 Summary of the Activities of the *ad hoc* Group of Experts on Harmful Algal Blooms
- 3.2.2 Recommendations of the *Ad hoc* Group of Experts on Harmful Algal Blooms
- 3.2.3 Discussion on the Report of the *ad hoc* Group of Experts on Harmful Algal Blooms

4. COOPERATION WITH OTHER PROGRAMMES

4.1 INTERNATIONAL PROGRAMME FOR THE DYNAMICS AND OCEANOGRAPHY OF COASTAL AND SHELF SEAS AND EXCHANGES

4.2 OTHER PROGRAMMES RELATED TO OSLR
- 4.2.1 The US Global Ocean Ecosystem Dynamics Programme (GLOBEC)
- 4.2.2 The USSR Programme on Integrated Studies and Monitoring of Marine Ecosystems Exposed to Antropogenic Impact and Global Climatic Change (ECOMONOC)
- 4.2.3 Ecosystem Dynamics Initiative in Brazil (BICED)

4.3 INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME (IGBP) AND PREDICTED GLOBAL CLIMATE CHANGES

4.4 CONTINUOUS PLANKTON RECORDER PROGRAMME (CPR)

5. **REQUIREMENTS FOR ONGOING AND PLANNED ACTIVITIES**

5.1 ECOSYSTEMS DYNAMICS IN RELATION TO LIVING RESOURCES (EDLR)
5.2 INTER-REGIONAL EXPANSION OF OSLR ACTIVITIES
5.3 OSLR NEWSLETTER

6. **ELECTION OF OFFICERS OF THE GUIDING GROUP**

7. **DATES AND PLACE OF THE FOURTH SESSION OF THE GUIDING GROUP**

8. **ADOPTION OF THE SUMMARY REPORT AND RECOMMENDATIONS OF THE SESSION**

9. **CLOSURE**

ANNEX II

RECOMMENDATIONS

Recommendation OSLR-III.1

SARDINE ANCHOVY RECRUITMENT PROJECT

The Guiding Group of Experts,

Noting with satisfaction the substantial progress achieved in different regions as to the implementation of different elements of the original SARP concept as stated in the Halifax Workshop and the First and Second Sessions of OSLR,

Having noted that the special *ad hoc* Experts Consultation in La Jolla recommended broadening the scope of SARP, but did not take full advantage of a reformulated version of the original SARP protocol,

Recognizing that there are elements and approaches, not included in the original proposal, that could make a significant contribution to the understanding of recruitment processes in sardine, anchovy and other epipelagic clupeoform species,

Having noted that there is a renewed interest in clupeiform recruitment studies by Member States and within other regional organizations and IOC subsidiary bodies,

Recognizing the potential value of up-dated, within year, high resolution experiments that are less demanding logistically than the original SARP protocol, but nevertheless scientifically worthwhile,

Recommends that the original definition of SARP as a focused experiment be revised, either by convening a sub-group of the GGE or consulting by correspondence among its Members, paying particular attention to constraints due to funding, facilities and expertise available.

Recommendation OSLR-III.2

TRODERP IN THE IOCARIBE REGION

The Guiding Group of Experts,

Recommends the implementation of the IOCARIBE-TRODERP proposals as defined during the Workshop held in Caracas in September 1989.

Recommendation OSLR-III.3

WESTPAC PRAWN RECRUITMENT PROJECT

The Guiding Group of Experts,

Recognizing with great satisfaction the successful implementation of the PREP-WESTPAC initiative,

Recommends:

(i) implementation of the project priorities as defined in the first National Co-ordinators' meeting; (ii) that a workshop should be held in early 1991 to evaluate data sets and to make geographic comparisons on penaeid recruitment

dynamics; (iii) that the scientists involved in the PREP initiative should receive additional training using TEMA and other training programmes; and (iv) that the IOC and FAO should contact the institutions of the participating laboratories stating that the WESTPAC-PREP has a high priority within OSLR/IREP.

Recommendation OSLR-III.4

SATELLITE OCEANOGRAPHY ANALYSIS FOR RECRUITMENT

The Guiding Group of Experts,

Recognising that new satellite oceanography applications provide high quality information for process-oriented research on recruitment, and that their utilization spans all OSLR/IREP sub-programmes,

Recommends that a workshop, convened by Dr. A. Vastano, be supported for active OSLR/IREP research scientists to: review remote sensing developments, explore specific adaptations and applications, and initiate technological exchanges.

Recommendation OSLR-III.5

COLLABORATION AND EXCHANGE BETWEEN OSLR AND ICES

The Guiding Group of Experts,

Noting with satisfaction the renewed interest from ICES in OSLR and particularly in IREP,

Recommends that IOC continue to pursue opportunities for collaboration and information exchange with ICES in the field of OSLR. In particular, the agreement of ICES should be sought by the IOC Secretariat, to enable scientists to attend relevant ICES activities on behalf of IOC-FAO/OSLR.

Recommendation OSLR-III.6

FUNDING OF OSLR OBSERVERS

The Guiding Group of Experts,

Recognising the importance of several recently developed activities of ICES that are highly relevant to OSLR,

Recommends that IOC-FAO provide funding for scientists to represent OSLR as observers. Particularly, priority should be given to the:

(i) ICES/OSLR Study Group on Modelling of Recruitment Processes (May 1990 in Paris); (ii) Theme Session on Trophic Models of Marine Ecosystems: Construction and Comparison (October 1990, Copenhagen); (iii) Theme Session on SARP (October 1991, France); (iv) Recruitment Processes Working Group (June 1990, Nantes); (v) North Atlantic Cod Study (on-going); (vi) Mini Symposium on Models of Recruitment Processes (October 1991, France); and (vii) Working Group on Phytoplankton and Management of Harmful Effects (annual).

Recommendation OSLR-III.7

ENDORSEMENT OF THE RECOMMENDATIONS MADE BY THE *AD HOC* GROUP OF EXPERTS ON HARMFUL ALGAL BLOOMS

The Guiding Group of Experts,

Recommends that the IOC Executive Council accept the recommendations of the *ad hoc* Group of Experts on Harmful Algal Blooms (Document IOC/INF-817).

Recommendation OSLR-III.8

IMPLEMENTATION OF THE HARMFUL ALGAL BLOOMS SUB-PROGRAMME

The Guiding Group of Experts,

Recommends that IOC take steps to turn the general recommendations of the *ad hoc* Group of Experts on Harmful Algal Blooms into specific plans for action, emphasizing establishment of a database and communications network, monitoring programmes, manual for methodologies, and advanced intercalibration exercise.

Recommendation OSLR-III.9

INTERNATIONAL PROGRAMME FOR THE DYNAMICS AND OCEANOGRAPHY OF COASTAL AND SHELF SEAS AND EXCHANGES

The Guiding Group of Experts,

Recommends that the IOC Executive Council take steps to facilitate the close collaboration of OSLR and this new programme as its implementation proceeds.

Recommendation OSLR-III.10

CONTINUOUS PLANKTON RECORDER PROGRAMME

The Guiding Group of Experts,

Recognizing the unique character of the long-term data sets on plankton abundance in the North-east Atlantic,

Recommends that the Continuous Plankton Recorder Programme be continued and expanded. Because of the great importance in monitoring the impacts of climate change on the oceanic biota, ways to broaden both the financial support and the geographic coverage of the Continuous Plankton Recorder Programme should be sought.

Recommendation OSLR-III.11

ECOSYSTEM DYNAMICS AND LIVING RESOURCES

The Guiding Group of Experts,

Recognizing the natural evolution of OSLR activities towards system integration,

Also recognizing the need for interphasing and complementing efforts with other initiatives active or being planned in this area of research,

Noting with concern that prediction of the impacts of climate change on marine ecosystems and resources have not received the attention they deserve, given the magnitude of the socio-economic consequences these changes will have on Member States which economies depend to a significant extent on the

exploitation of marine resources,

Taking note of the existence of national and regional programmes oriented to furthering the understanding of marine ecosystems dynamics (ECOMONOC, GLOBEC, BICED),

Recommends the establishment of a special sub-programme "Ecosystem Dynamics and Living Resources" within OSLR, with the specific aim of providing a system overview that, through extensive use of the comparative method, would improve the ability to predict the impact of climate change on living resources;

Requests the IOC Secretariat to organize an *ad hoc* Expert Consultation, convened by Dr. Daniel Pauly, to develop details of the proposed sub-programme EDLR.

Recommendation OSLR-III.12

RECONSTITUTION OF THE GUIDING GROUP

The Guiding Group of Experts,

Recognizing the expansion of OSLR programmes both in scope and geographic extent, and the recent tendency for specific research programmes (i.e., Harmful Algal Blooms, Ecosystem Dynamics and Living Resources) to be formulated by *ad hoc* consultations of subject specialists,

Recommends that the Group be reconstituted (taking into account the need for some level of continuity in participation) to provide a broader overview of OSLR activity, and to reflect the needs of developing countries, particularly in the IOCINDIO, IOCINCWIO and IOCEA regions.

Recommendation OSLR-III.13

OSLR NEWSLETTER

The Guiding Group of Experts,

Reporting with pleasure that Dr. P. Bernal would be willing to serve as Editor of the OSLR Newsletter which the IOC Assembly, at its fourteenth session, recommended, should be started,

Recommends that IOC and FAO set aside the funds and such other support as may be necessary to produce the OSLR Newsletter on the basis of a budget to be prepared by Dr. Bernal.

Recommendation OSLR-III.14

TECHNICAL SECRETARY FOR OSLR

The Guiding Group of Experts,

Recognizing the growing involvement and interest of developing countries in OSLR, the development of complementary programmes in developed countries (e.g., GLOBEC, ECOMONOC, MOSES), and the expansion of OSLR activity (including Harmful Algal Blooms, EDLR), a full time Technical Secretary for OSLR is crucial if OSLR is to remain a viable programme,

Strongly recommends that IOC and FAO pursue all possible options (including secondment) to provide a full time Technical Secretary for OSLR.

ANNEX III

LIST OF PARTICIPANTS

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ANNEX IV

LIST OF DOCUMENTS

Code	Title
IOC-FAO/GGE-OSLR-III/1	Agenda
IOC-FAO/GGE-OSLR-III/2	WESTPAC Penaeid Recruitment Project
IOC-FAO/GGE-OSLR-III/3	Summary Report
IOC-FAO/GGE-OSLR-III/4	List of Documents
IOC-FAO/GGE-OSLR-III/5	List of Participants
IOC-FAO/GGE-OSLR-III/6	GLOBEC
IOC-FAO/GGE-OSLR-III/7	Relationship between GLOBEC and IOC
IOC-FAO/GGE-OSLR-III/8	WESTPAC OSLR Intersessional Activities
IOC-FAO/GGE-OSLR-III/9	*Ad hoc* Expert Consultation on SARP
IOC-FAO/GGE-OSLR-III/10	Executive Summary of Report of Meeting of OSLR Experts on Harmful Algal Blooms

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**N.B. This list is for reference only.
No stocks of these documents are maintained, except for the Summary Report.**